PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 06 April 2001 (06.04.01)	
International application No. PCT/GB00/02878	**Applicant's or agent's file reference** SMC 60371/WO
International filing date (day/month/year) 26 July 2000 (26.07.00)	**Priority date** (day/month/year) 13 August 1999 (13.08.99)
Applicant PAYNE, John, David et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

06 February 2001 (06.02.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Juan Cruz

Telephone No.: (41-22) 338.83.38

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For re Office use only

International Application No.

International Filing Date

10/049346

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* SMC 60371/WO

Box No. I TITLE OF INVENTION

Air Filter

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

Avecia Limited
Hexagon House
Blackley
Manchester M9 8ZS
United Kingdom

☐ This person is also inventor.

Telephone No.
0161 740 1460

Facsimile No.
0161 721 5801

Teleprinter No.

State *(that is, country)* of nationality: GB

State *(that is, country)* of residence: GB

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

PAYNE, John David
PO Box 42, Hexagon House
Blackley
Manchester M9 8ZS
United Kingdom

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: GB

State *(that is, country)* of residence: GB

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

REVELL, Christopher
Intellectual Property Group
Avecia Limited
PO Box 42, Hexagon House
Blackley
Manchester M9 8ZS
United Kingdom

Telephone No.
0161 721 1142

Facsimile No.
0161 721 5801

Teleprinter No.

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

DUKES, Helen
PO Box 42, Hexagon House
Blackley
Manchester M9 8ZS
United Kingdom

This person is:
- [ ] applicant only
- [x] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: GB

State *(that is, country)* of residence: GB

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [x] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

- [ ] Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No. V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

- [X] **AP** **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **SD** Sudan, **SL** Sierra Leone, **SZ** Swaziland, **TZ** United Republic of Tanzania, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- [X] **EA** **Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- [X] **EP** **European Patent:** **AT** Austria, **BE** Belgium, **CH and LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- [X] **OA** **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* . . . . . .

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- [X] **AE** United Arab Emirates
- [X] **AL** Albania . . . . . .
- [X] **AM** Armenia . . . . . .
- [X] **AT** Austria . . . . . .
- [X] **AU** Australia . . . . . .
- [X] **AZ** Azerbaijan
- [X] **BA** Bosnia and Herzegovina . . . . . .
- [X] **BB** Barbados
- [X] **BG** Bulgaria . . . . . .
- [X] **BR** Brazil . . . . . .
- [X] **BY** Belarus . . . . . .
- [X] **CA** Canada
- [X] **CH and LI** Switzerland and Liechtenstein
- [X] **CN** China . . . . . .
- [X] **CR** Costa Rica . . . . . .
- [X] **CU** Cuba . . . . . .
- [X] **CZ** Czech Republic . . . . . .
- [X] **DE** Germany . . . . . .
- [X] **DK** Denmark . . . . . .
- [X] **DM** Dominica
- [X] **EE** Estonia . . . . . .
- [X] **ES** Spain . . . . . .
- [X] **FI** Finland . . . . . .
- [X] **GB** United Kingdom
- [X] **GD** Grenada
- [X] **GE** Georgia . . . . . .
- [X] **GH** Ghana . . . . . .
- [X] **GM** Gambia
- [X] **HR** Croatia . . . . . .
- [X] **HU** Hungary . . . . . .
- [X] **ID** Indonesia
- [X] **IL** Israel . . . . . .
- [X] **IN** India . . . . . .
- [X] **IS** Iceland
- [X] **JP** Japan . . . . . .
- [X] **KE** Kenya . . . . . .
- [X] **KG** Kyrgyzstan . . . . . .
- [X] **KP** Democratic People's Republic of Korea . . . . . .
- [X] **KR** Republic of Korea . . . . . .
- [X] **KZ** Kazakhstan . . . . . .
- [X] **LC** Saint Lucia
- [X] **LK** Sri Lanka
- [X] **LR** Liberia
- [X] **LS** Lesotho . . . . . .
- [X] **LT** Lithuania
- [X] **LU** Luxembourg
- [X] **LV** Latvia
- [X] **MA** Morocco . . . . . .
- [X] **MD** Republic of Moldova . . . . . .
- [X] **MG** Madagascar . . . . . .
- [X] **MK** The former Yugoslav Republic of Macedonia . . . . . .
- [X] **MN** Mongolia
- [X] **MW** Malawi . . . . . .
- [X] **MX** Mexico . . . . . .
- [X] **NO** Norway
- [X] **NZ** New Zealand . . . . . .
- [X] **PL** Poland . . . . . .
- [X] **PT** Portugal . . . . . .
- [X] **RO** Romania
- [X] **RU** Russian Federation . . . . . .
- [X] **SD** Sudan
- [X] **SE** Sweden
- [X] **SG** Singapore
- [X] **SI** Slovenia . . . . . .
- [X] **SK** Slovakia . . . . . .
- [X] **SL** Sierra Leone . . . . . .
- [X] **TJ** Tajikistan . . . . . .
- [X] **TM** Turkmenistan . . . . . .
- [X] **TR** Turkey . . . . . .
- [X] **TT** Trinidad and Tobago . . . . . .
- [X] **TZ** United Republic of Tanzania
- [X] **UA** Ukraine . . . . . .
- [X] **UG** Uganda . . . . . .
- [X] **US** United States of America . . . . . ~~continuation in part~~ . . . . . .
- [X] **UZ** Uzbekistan . . . . . .
- [X] **VN** Viet Nam . . . . . .
- [X] **YU** Yugoslavia . . . . . .
- [X] **ZA** South Africa . . . . . .
- [X] **ZW** Zimbabwe . . . . . .

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

- [X] DZ Algeria . . . . . [X] MZ Mozambique . . . . . .
- [X] AG Antigua and Barbuda . . . . . [X] BZ Belize . . . . . .

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

Supplemental Box *If the Supplem[illegible]Box is not used, this sheet should not be includ[illegible]e request.*

*1. If, in any of the Boxes, **the space is insufficient** to furnish all the information: in such case, write "Continuation of Box No. ..." [indicate the number of the Box] and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:*

*(i) **if more than two persons are involved as applicants and/or inventors** and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;*

*(ii) if, in Box No. II or in any of the sub-boxes of Box No. III, the indication **"the States indicated in the Supplemental Box"** is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;*

*(iii) if, in Box No. II or in any of the sub-boxes of Box No. III, **the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America**: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;*

*(iv) if, in addition to the agent(s) indicated in Box No. IV, there are **further agents**: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;*

*(v) if, in Box No. V, the name of any State (or OAPI) is accompanied by the indication **"patent of addition,"** or **"certificate of addition,"** or if, in Box No. V, the name of the United States of America is accompanied by an indication **"continuation"** or **"continuation-in-part"**: in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;*

*(vi) if, in Box No. VI, there are **more than three earlier applications whose priority is claimed**: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI;*

*(vii) if, in Box No. VI, **the earlier application is an ARIPO application**: in such case, write "Continuation of Box No. VI", specify the number of the item corresponding to that earlier application and indicate at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed.*

*2. If, with regard to the **precautionary designation statement** contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.*

*3. If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning **non-prejudicial disclosures or exceptions to lack of novelty**: in such case, write "Statement concerning non-prejudicial disclosures or exceptions to lack of novelty" and furnish that statement below.*

Continuation of Box IV

FAWKES, David Melville
LOCKE, Timothy John
MAYALL, John
PUGSLEY, Roger Graham
SCHMITT, Maja
SHELLER, Alan

All of Intellectual Property Group, Avecia Limited, PO Box 42, Hexagon House, Blackley, Manchester M9 8ZS, United Kingdom

Box No. VI PRIORITY CLAIM ☐ Further priority claim indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) 13 August 1999 13/08/1999	9919127.2	GB		
item (2)				
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): 1

** Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)* :

ISA / EPO

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets**:

request	: 05
description (excluding sequence listing part)	: 17
claims	: 02
abstract	: 01
drawings	:
sequence listing part of description	:
Total number of sheets	: 25

This international application is **accompanied by** the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract:

Language of filing of the international application: ENGLISH

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

For Avecia Limited - PAYNE, JD and DUKES, H

REVELL, Christopher

For receiving Office use only

1. Date of actual receipt of the purported international application:
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA /
6. ☐ Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

To:
AVECIA Limited
Intellectual Property Group
Attn. REVELL, Christopher
PO Box 42, Hexagon House
Blackley
Manchester M9 8ZS
UNITED KINGDOM

Date of mailing *(day/month/year)* 08/11/2000	
Applicant's or agent's file reference SMC 60371/WO	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/GB 00/02878	International filing date *(day/month/year)* 26/07/2000
Applicant AVECIA LIMITED	

1. [X] The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Fascimile No.: (41-22) 740.14.35

DATE 9/11/00 INITIALS GT

For more detailed instructions, see the notes on the accompanying sheet.

2. [ ] The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. [ ] **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Véronique Baillou

Form PCT/ISA/220 (July 1998)

NOTE FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

(i) the claim is unchanged;

(ii) the claim is cancelled;

(iii) the claim is new;

(iv) the claim replaces one or more claims as filed;

(v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."

2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."

3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."

4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international appplication is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
SMC 60371/WO		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 00/ 02878	26/07/2000	13/08/1999
Applicant		
AVECIA LIMITED		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. _____

   [ ] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [X] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PC[redacted]B 00/02878

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B01D39/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DATABASE WPI Section Ch, Week 198713 Derwent Publications Ltd., London, GB; Class D22, AN 1987-091375 XP002150935 & JP 62 042715 A (TOYOBO KK), 24 February 1987 (1987-02-24) abstract -----	

☐ Further documents are listed in the continuation of box C.

☐ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 October 2000	08/11/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Polesak, H

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PC[redacted]B 00/02878

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 62042715 A	24-02-1987	NONE	

XP-002150935

AN - 1987-091375 [13]
AP - JP19850179026 19850814
CPY - TOYM
DC - D22 E19 J01 Q74
FS - CPI;GMPI
IC - B01D39/14 ; F24F7/00
MC - D09-B E05-E02D E10-A17 E10-E02F J01-G04 J01-H
M3 - [01] B414 B713 B720 B741 B831 H1 H181 K0 L7 L722 M210 M211 M225 M231 M272 M273 M283 M313 M321 M332 M342 M361 M391 M411 M510 M520 M530 M540 M620 M781 M903 M904 P200 Q130 Q431; R06654-U
- [02] G015 G019 G100 H4 H401 H441 H5 H541 H6 H602 H609 H643 H8 M1 M121 M141 M280 M320 M414 M510 M520 M532 M540 M781 M903 M904 P200 Q130 Q431; R01614-U
- [03] K0 L2 L240 M280 M320 M416 M620 M781 M903 M904 P200 Q130 Q431; R03018-U
PA - (TOYM) TOYOBO KK
PN - JP62042715 A 19870224 DW198713 004pp
PR - JP19850179026 19850814
XA - C1987-038219
XIC - B01D-039/14 ; F24F-007/00
XP - N1987-068417
AB - J62042715 A composite membrane consists of multiple nonwoven fabric layers (1) for electret filter, and nonwoven fabric layer (2) at least treated with antimicrobial agent on one side.
- The antimicrobial agent is e.g. 3-trimethyloxy styryl-propyl dimethyl -octadecyl-ammonium chloride (DC 5700, DOW CORNING (RTM)), 2,4,4'-trichloro -2'-hydroxy diphenyl ether (ILUGASAN DP300 (RTM)), biguanide. The amt. of the antimicrobial agent is e.g. 0.1-1.0 wt. A binding method of both nonwoven fabrics is e.g. sewing or laying simply, pref. needle punching.
- USE/ADVANTAGE - The filter is useful for dust removing filter of a cleaner, an air cleaner or an air conditioner. Increasing of microbe in filter is effectively inhibited. The filter prevents decrease of an electric efficiency, spoiling of an adhesive material and prodn. of bad smell.(0/2)
CN - R01614-U R03018-U R06654-U
IW - ANTIMICROBIAL COMPOSITE MEMBRANE ELECTRET FILTER CONSIST MULTIPLE NONWOVEN FABRIC LAYER USEFUL DUST REMOVE AIR CLEAN CONDITION
IKW - ANTIMICROBIAL COMPOSITE MEMBRANE ELECTRET FILTER CONSIST MULTIPLE NONWOVEN FABRIC LAYER USEFUL DUST REMOVE AIR CLEAN CONDITION
NC - 001
OPD - 1985-08-14
ORD - 1987-02-24
PAW - (TOYM) TOYOBO KK
TI - Antimicrobial composite membrane for electret filter use - consists of multiple nonwoven fabric layers, esp. useful for dust remover, air cleaner or conditioner

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

REVELL, Christopher
AVECIA Limited
Intellectual Property Group
PO Box 42, Hexagon House
Blackley
Manchester M9 8ZS
GRANDE BRETAGNE

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	16.05.2001
Applicant's or agent's file reference: SMC 60371/WO	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/02878	26/07/2000	13/08/1999

Applicant: AVECIA LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

21/5/01 GT

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Fuerbass, C Tel.+49 89 2399-8132

Form PCT/IPEA/416 (July 1992)

TENT COOPERATION TR Y

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
SMC 60371/WO		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/02878	26/07/2000	13/08/1999
International Patent Classification (IPC) or national classification and IPC B01D39/20		
Applicant AVECIA LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
06/02/2001	16.05.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Polesak, H Telephone No. +49 89 2399 8628

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/02878

I. Basis of the r port

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

   1-17 as originally filed

   Claims, No.:

   1-14 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   ☐ the language of publication of the international application (under Rule 48.3(b)).
   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.
   ☐ filed together with the international application in computer readable form.
   ☐ furnished subsequently to this Authority in written form.
   ☐ furnished subsequently to this Authority in computer readable form.
   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:
   ☐ the claims, Nos.:
   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-14
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-14
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-14
	No:	Claims	

2. Citations and explanations
see separate sheet

R garding Point V

(1) DATABASE WPI Section Ch, Week 198713 Derwent Publications Ltd., London, GB; Class D22, AN 1987-091375 XP002150935 of JP-A- 62 042715 (TOYOBO KK), 24 February 1987 (1987-02-24)

1. The closest prior art is represented by document (1). Document (1) teaches an air filter consisting of a filter medium containing an antimicrobial agent. The antimicrobial agent is biguanide.

2. The antimicrobial air filter of claim 1 is distinguished from that of document (1) by the feature that the antimicrobial agent is **polymeric** biguanide.

3. The requirements of Article 33(2) PCT regarding novelty are hence met. The objective that is solved by the features of present claim 1, is to provide a more efficient antimicrobial air filter that exhibits activity against a broad spectrum of micro-organisms. Addionally the polymeric biguanides have low toxicity and enhanced substantivity on the filter medium.

4. Although document (1) describes an antimicrobial air filter comprising biguanide, the use of **polymeric** biguanide as an antimicrobial agent in air filters cannot be deduced from document (1). The approach of the present application is hence not obvious in the light of the prior art, hence the air filter of claim 1 also satisfies the requirements of Article 33(3) PCT as regards inventive activity.

5. Independent claim 12 which claims a method of reducing odours by using the air filter of claim 1 and independent claim 14 which claims a method for protecting a filter medium by using **polymeric** biguanides also comply with PCT Articles 33 (2)-(4).

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 February 2001 (22.02.2001)

PCT

(10) International Publication Number
WO 01/12296 A1

(51) International Patent Classification[7]: B01D 39/20

(21) International Application Number: PCT/GB00/02878

(22) International Filing Date: 26 July 2000 (26.07.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
9919127.2 13 August 1999 (13.08.1999) GB

(71) Applicant *(for all designated States except US)*: **AVECIA LIMITED** [GB/GB]; Hexagon House, Blackley, Manchester M9 8ZS (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **PAYNE, John, David** [GB/GB]; Hexagon House, P.O. Box 42, Blackley, Manchester M9 8ZS (GB). **DUKES, Helen** [GB/GB]; Hexagon House, P.O. Box 42, Blackley, Manchester M9 8ZS (GB).

(74) Agents: **REVELL, Christopher** et al.; Intellectual Property Group, Avecia Limited, Hexagon House, P.O. Box 42, Blackley, Manchester M9 8ZS (GB).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 01/12296 A1

(54) Title: AIR FILTER

(57) Abstract: An air filter for a circulating and/or recirculating air system comprising a filter medium containing a microbiologicaly effective amount of a polymeric biguanide or salt thereof. Also claimed is a method for reducing odours and/or air-borne micro-organisms in a circulating or recirculating air system using the air filter, and a method for protecting an air filter medium against microbial degradation by incorporating in, or on, the medium a microbiologically effective amount of a polymeric biguanide or salt thereof.

AIR FILTER

The present invention relates to an air filter for a circulating and/or recirculating air system comprising a filter medium containing a biologically effective amount of a polymeric biguanide. The invention also relates to a method for reducing odours and air-borne micro-organisms comprising passing air through a filter medium containing the biologically effective amount of a polymeric biguanide.

Air filters are commonly used to remove particulate matter in a wide range of air circulation systems. They may be in the form of bags or envelopes (commonly known as Sack filters) through which air is blown or as pads or papers which are used in a frame. Sack filters have a high collection efficacy for removing particles such as dust and combustion products such as tobacco smoke. The filtration media used in air filters is made from a wide range of materials but is most commonly a woven or non-woven fabric.

Examples of air systems which incorporate these filters include the air conditioning and central heating systems of residential, office and recreational buildings, aeroplanes, automobiles and hospitals. The filtration requirements of different environments varies widely. Air filtration is of particular importance in industrial clean rooms and especially in hospital environments such as wards and surgical rooms.

Air-borne micro-organisms can cause a particular problem in air filtration systems since after removal from the air stream they can remain viable on the filtration medium. This can result in a proliferation of these micro-organisms and lead to widespread contamination of the air circulation system. This in turn can have wide ranging effects varying from a reduction in filter efficiency to the generation of foul odours from odoriferous microbial by-products. In addition the presence of large numbers of microbes in re-circulating air has been implicated as a possible cause of "sick building syndrome". To avoid these problems the filtration medium may be treated with antimicrobial agents to inhibit the growth of microbes such as bacteria, fungi, viruses, algae, yeasts and protozoa.

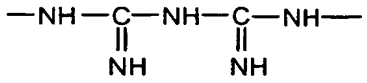
A particular problem in hospital environments is the control or elimination of pathogens, especially Gram-positive pathogens, for example *Staphylococci*, *Enterococci*, *Streptococci* and *mycobacteria*. Many of these pathogens have developed resistant strains, for example *methicillin resistant staphylococcus* (MRSA), *methicillin resistant coagulase negative staphylococci* (MRCNS), *penicillin resistant Streptococcus pneumoniae* and *multiply resistant Enterococcus faecium*. Once established these resistant strains are difficult to treat and eradicate from the hospital environment because they are resistant to conventional antibiotics such as penicilin and methacillin. The particulate matter collected in air filter media, especially organic matter, can act as a source of nutrients for such resistant pathogens and result in their proliferation both on the filter and into the air stream passing through the filter. There is therefore a need for an air

filter which inhibits or eliminates the growth of such pathogens. Hitherto this has proved difficult to achieve.

We have found that the incorporation of a polymeric biguanide or salt thereof in or on the filtration medium used in air filters results in the filtration medium exhibiting excellent activity against a range of micro-organisms and that air which has passed through such filter medium exhibits reduced odour and/or a reduction in air-borne micro-organisms. These biguanides show advantage over alternative antimicrobial agents in their broad spectrum of activity, low toxicity, ease of application and substantivity on the filter medium.

According to a first aspect of the present invention there is provided an air-filter for a circulating and/or recirculating air system comprising a filter medium containing a microbiologically effective amount of a polymeric biguanide or salt thereof.

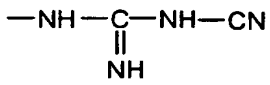
Preferably, the polymeric biguanide contains at least two biguanide units of Formula (1):



(1)

which are linked by a bridging group which contains at least one methylene group. The bridging group may include a polymethylene chain which may be optionally substituted by hetero atoms such as oxygen, sulphur or nitrogen. The bridging group may include one or more cyclic nuclei which may be saturated or unsaturated. Preferably, the bridging group is such that there are at least three, and especially at least four, carbon atoms directly interposed between two adjacent biguanide units of formula 1. Preferably, there are not greater than 10 and especially not greater than eight carbon atoms interposed between two adjacent biguanide units of Formula (1).

The polymeric biguanide may be terminated by any suitable group which may be a hydrocarbyl or substituted hydrocarbyl group or an amine or a cyanoguanidine group.

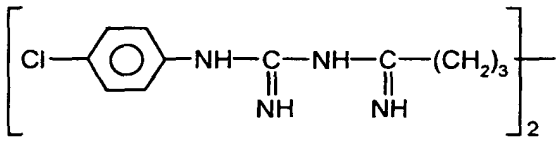


When the terminating group is a hydrocarbyl group, it may be alkyl, cycloalkyl or aralkyl.

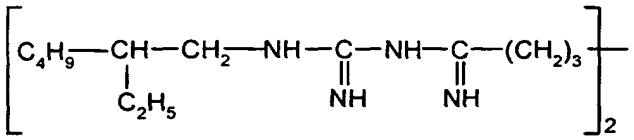
When the terminating group is a substituted hydrocarbyl group, the substituent may be any substituent that does not exhibit undesirable adverse effects on the microbiological properties of the polymeric biguanide. Examples of such substituents or substituted hydrocarbyl groups are aryloxy, alkoxy, acyl, acyloxy, halogen and nitrile.

When the polymeric biguanide contains two biguanide groups of formula 1, the two biguanide groups are preferably linked through a polymethylene group, especially a hexamethylene group and the biguanide is a bisbiguanide.

The terminating groups in such bisbiguanides are preferably C_{1-10}-alkyl which may be linear or branched and optionally substituted aryl, especially optionally substituted phenyl. Examples of such terminating groups are 2-ethyl hexyl and 4-chloro phenyl. Specific examples of such bisbiguanides are compounds represented by Formula (2) and (3) in the free base form.

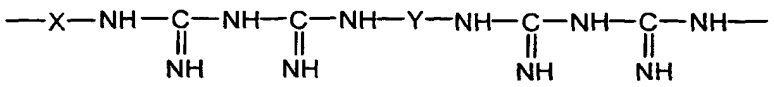


(2)



(3)

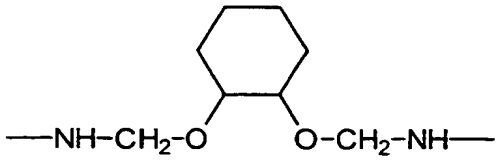
The polymeric biguanide preferably contains more than two biguanide units of Formula (1) and is preferably a linear polymeric biguanide which has a recurring polymeric chain represented by Formula (4):



(4)

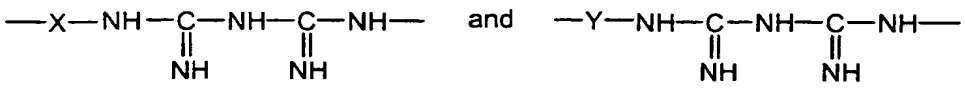
wherein X and Y represent bridging groups in which together the total number of carbon atoms directly interposed between the pairs of nitrogen atoms linked by X and Y is more than 9 and less than 17.

The bridging groups X and Y may consist of polymethylene chains, optionally interrupted by hetero atoms, for example, oxygen, sulphur or nitrogen. X and Y may also incorporate cyclic nuclei which may be saturated or unsaturated, in which case the number of carbon atoms directly interposed between the pairs of nitrogen atoms linked by X and Y is taken as including that segment of the cyclic group, or groups, which is the shortest. Thus, the number of carbon atoms directly interposed between the nitrogen atoms in the group.



is 4 and not 8.

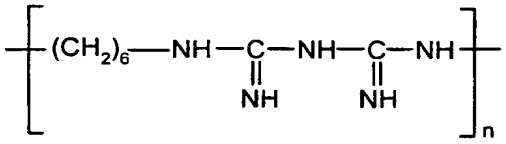
The linear polymeric biguanides having a recurring polymer unit of Formula (4) are typically obtained as mixtures of polymers in which the polymer chains are of different lengths. Preferably, the number of individual biguanide units of formulae:



is, together, from 3 to about 80, wherein X and Y are as hereinbefore defined.

Preferably X and Y are each, independently a polymethylene chain, more preferably hexamethylene (i.e. $-(CH_2)_6-$).

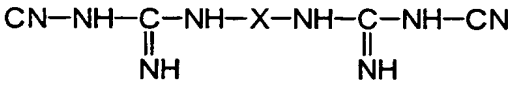
The preferred linear polymeric biguanide is a mixture of polymer chains represented by Formula (5) in the free base form:



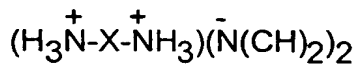
(5)

wherein n is from 4 to 40 and especially from 4 to 15. It is especially preferred that the average value of n is about 12. Preferably, the average molecular weight of the polymer in the free base form is from 1100 to 3300.

Linear biguanides may be prepared by the reaction of a bisdicyandiamide having the formula:



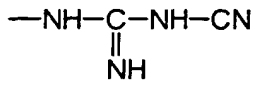
with a diamine $H_2N\text{-}Y\text{-}NH_2$, wherein X and Y have the meanings defined above or by reaction between a diamine salt or dicyanimide having the formula:



with a diamine $H_2N\text{-}Y\text{-}NH_2$ wherein X and Y have the meanings defined above. These methods of preparation are described in UK specifications numbers 702,268 and

1,152,243 respectively, and any of the polymeric biguanides described therein may be used.

As noted hereinbefore, the polymer chains of the linear polymeric biguanides may be terminated either by an amino group or by a cyanoguanidine group.



This cyanoguanidine group can hydrolyse during preparation of the linear polymeric biguanide yielding a guanidine end group. The terminating groups may be the same or different on each polymer chain.

A small proportion of a primary amine $R\text{-}NH_2$, where R represents an alkyl group containing from 1 to 18 carbon atoms, may be included with the diamine $H_2N\text{-}Y\text{-}NH_2$ in the preparation of polymeric biguanides as described above. The primary monoamine acts as a chain-terminating agent and consequently one or both ends of the polymeric biguanide polymer chains may be terminated by an -NHR group. These chain-stopped polymeric biguanides may also be used.

The polymeric biguanides readily form salts with both inorganic and organic acids. The choice of acid depends primarily on whether a water soluble or water insoluble salt of the polymeric biguanide is desired for the preparation of the air filter. The choice of salt will depend largely on the type of medium used as the filter. In many instances, it will be convenient to use a water soluble salt of the polymeric biguanide. Where the polymeric biguanide is represented by a compound of Formula (2) in the free base form, a preferred water soluble salt is the digluconate. Where the polymeric biguanide is represented by a compound of Formula (3) in the free base form, a preferred water soluble salt is the diacetate and where the much preferred polymeric biguanide is a mixture of linear polymers represented by Formula (5) in the free base form, the preferred salt is the hydrochloride.

The polymeric biguanide will also form solvent soluble salts with organic acids containing from 4 to 30 carbon atoms. The organic acid which forms the solvent soluble salt with the polymeric biguanide may contain a phosphonic, phosphoric, sulphonic or sulphate group but preferably contains a carboxylic acid group. The organic acid may be aromatic but is preferably aliphatic, including alicyclic. When the organic acid is aliphatic, the aliphatic chain of the organic acid may be linear or branched, saturated or unsaturated, including mixtures thereof. Preferably, the aliphatic chain is linear and it is also preferred that the organic acid is an aliphatic carboxylic acid.

It is preferred that the organic acid which forms the solvent soluble salt with the polymeric biguanide contains not less than eight, more preferably not less than ten and especially not less than twelve carbon atoms excluding the acid group. Preferably, the

organic acid contains not greater than 24, more preferably not greater than 20 and especially not greater than 18 carbon atoms excluding the acid group.

The organic acid which forms the solvent soluble salt with the polymeric biguanide may contain more than one acid group but it is preferred that only one such group is present.

The organic acid which forms the solvent soluble salt with the polymeric biguanide may be substituted by a halogen or particularly a hydroxy group. It is, however, preferred that the organic acid is free from substituents.

Some aliphatic carboxylic acids are available commercially as mixtures such as those obtained from animal fats and vegetable oils and these contain both saturated and unsaturated aliphatic chains. These have also been found useful, especially the C_{14-18}-alkyl carboxylic acids and their fully saturated or hydrogenated analogues.

Examples of optionally substituted carboxylic acids are valeric, hexanoic, octanoic, 2-octenoic, lauric, 5-dodecenoic, myristic, pentadecanoic, palmitic, oleic, stearic, eicosanoic, heptadecanoic, palmitoleic, ricinoleic, 12-hydroxystearic, 16-hydroxyhexadecanoic, 2-hydroxycaproic, 12-hydroxydodecanoic, 5-hydroxydodecanoic, 5-hydroxydecanoic, 4-hydroxydecanoic, dodecanedioic, undecanedioic, sebacic, benzoic, hydroxbenzoic and teraphthalic acids. The preferred organic aliphatic carboxylic acid is stearic acid.

The organic acid solvent soluble salt of the polymeric biguanide may be made by any method known to the art but is preferably made by precipitation of the biguanide from aqueous solution by addition of the organic acid under alkaline conditions. The organic acid salts of the biguanide may be further purified by dissolution in a suitable organic liquid which is preferably immiscible with water and washing the organic phase with water to remove any residual water soluble salts.

The filter medium may be made from natural polymer or synthetic polymeric plastics material. Examples of natural polymeric materials are cellulose, such as viscose and wood pulps; silicates such as glass; and wool. Examples of synthetic polymeric plastics materials include polyesters such as polyethylene terephthalate; polyamides such as nylon 6,6 and 6,10; polyurethanes; polyacrylamides including those containing carboxylic and sulphonic and groups; and polyolefines such as polyethylene and polypropylene. A preferred polymeric material is cellulose.

The filter medium may contain the polymeric material in any suitable physical form which allows for the passage of air. Thus, the polymeric material may be in the form of sheet, fibres, flakes, chips and granules, including combinations thereof. When the filter medium is made from fibres, it may be either woven or non-woven. The non-woven fibres may be either dry-laid or wet-laid and are preferably in the form of a felt or sheet. It is preferred that the fibres are woven. Especially preferred fibres are cellulosic for example cotton or viscose fibres.

The amount of polymeric biguanide or salt thereof which is contained by the filter medium may vary over wide limits. Preferably, the amount of polymeric biguanide is not less than 0.0001%, more preferably not less than 0.05% and especially not less than 0.3% based on the weight of filter medium. It is also preferred that the amount of polymeric biguanide is not greater than 10%, more preferably not greater than 5% and especially not greater than 1% by weight of the filter medium. Useful effects have been obtained when the amount of polymeric biguanide is from 0.4% to 2% by weight of the filter medium.

The polymeric biguanide may be applied to the filter medium by any means known to the art. Thus, where the polymeric biguanide or its salt is a solid it may be added to the filter medium and uniformly distributed by mixing, such as stirring or shaking. Preferably, however, the polymeric biguanide is added to the filter medium from a solution or dispersion in an appropriate liquid medium. When the polymeric biguanide or its salt is soluble in water, the liquid medium is preferably water and when the polymeric biguanide is soluble in an organic liquid the liquid medium is preferably an organic solvent such as C_{1-4}-alkanols, ketones, ethers, esters, aromatic and aliphatic hydrocarbons including halogenated derivaties thereof. When desired the polymeric biguanide may also be applied from an emulsion which may be a water-in-oil or oil-in-water emulsion. When the polymeric biguanide is applied to the filter medium as a dispersion or emulsion it is preferably uniformly distributed throughout the continuous phase by means of an appropriate dispersant or emulsifying agent. When the filter medium is a synthetic polymeric plastics material, the polymeric biguanide may be uniformly distributed throughout the plastics material by any means known to the art such as coating granules, chips or flakes with the polymeric biguanide. Where the polymeric biguanide is applied from a liquid medium, the liquid is preferably removed by evaporation. The coated granules, chips or flakes may be fabricated into sheets or fibres by appropriate heat treatment such as melt extrusion and melt spinning. It is preferred, however, that the polymeric biguanide is applied to the surface of the filter medium.

It is especially preferred that the filter medium comprises cellulosic fibres and that the polymeric biguanide is PHMB in the form of its hydrochloride salt. It is also preferred that the PHMB is applied from aqueous solution.

In an embodiment of the present invention the air-filter further comprises an odour control agent. We have found that the presence of an odour control agent in conjunction with the polymeric biguanide is particularly effective for controlling odour when the air being filtered is contaminated by odorous components. Examples of such odorous components include combustion products such as smoke produced from tobacco products; fats and grease arising from the preparation of foods; and gaseous/volatile emissions resulting from the handling and processing of chemicals.

Suitable odour control agents include activated carbon, zeolites, cyclodextrins and undecylenic acids and derivatives thereof.

The odour control agent may be incorporated into the filter by any convenient means for example one of the methods hereinbefore discussed in relation to incorporating the polymeric biguanide. A preferred method is to impregnate the filter medium with a solution or dispersion containing the odour control agent. The solution or dispersion containing odour control agent may be applied before, after or simultaneously with the polymeric biguanide. It is preferred however, that when an odour control agent is used, it is incorporated into the filter separately from the medium containing the polymeric biguanide. This may be achieved for example by incorporating an additional filter medium impregnated with the odour control agent into the filter.

A preferred method for incorporating a solid odour control agent such as activated carbon is to incorporate it as a layer in the filter.

In a preferred embodiment of the present invention the filter medium comprises a hereinbefore described filter medium containing a polymeric biguanide and a layer containing the odour control agent. Preferably the layer containing the odour control agent is sandwiched between an inner and outer layer comprising one or more of the herinbefore described filter media, wherein at least one or preferably both, of the inner and outer layers contain the polymeric biguanide or salt thereof. It is especially preferred that the inner and outer layers comprise cellulosic fibres (especially cotton or non-woven viscose fabric) impregnated with PHMB (preferably in the form of its hydrochloride salt). It is also especially preferred that the odour control agent is selected from an activated carbon and a cyclodextrin.

It is known that micro-organisms grow and proliferate in the presence of an organic nutrient and water and that the growth of micro-organisms can be inhibited by contacting the micro-organism with a biologically active compound. This contact is generally mediated by water. It has now been found that the growth of micro-organisms in the filter medium of a circulating and/or recirculating air system grow and proliferate under "dry" conditions and can be inhibited by contacting the micro-organism with the filter medium containing a polymeric biguanide under "dry" conditions. By "dry" conditions it is meant air having a relative humidity between 20% and 80%. The filter medium containing the polymeric biguanide has been found especially effective at controlling odours and the growth of micro-organisms when the relative humidity of the circulating air is 55% $\pm$ 15%.

As noted hereinbefore, the filter medium containing the polymeric biguanide has been found to reduce odours in air circulated through the filter medium containing the polymeric biguanide and/or reduce the amount of air-borne micro-organisms. Thus, according to a further aspect of the invention there is provided a method of reducing odours and/or air-borne micro-organisms in circulating and/or recirculated air which comprises passing the air through a filter medium containing a polymeric biguanide.

Again, as noted supra, the growth of micro-organisms on or in the air-filter of a circulating and/or recirculating air system can reduce the efficacy of the air filter either by

inhibiting the flow of air through the filter caused by microbial growth and/or degradation of the filter medium. The incorporation of a polymeric biguanide in the air-filter mitigates against such loss of efficacy. Hence, according to a further aspect of the invention there is provided a method for protecting the filter medium of a circulating and/or recirculating air system against microbial degradation which comprises incorporating in, or on, the filter medium a microbiologically effective amount of a polymeric biguanide or salt thereof.

The polymeric biguanide may be applied to the filter medium using conventional methods known in the art, for example as discussed hereinbefore in relation to the first aspect of the present invention.

The invention is now further illustrated by the following non-limiting examples wherein all references are to parts and percentages by weight unless indicated to the contrary.

Example 1

Example 1 demonstrates that bacteria are able to survive on a "dry" cotton air filtration medium under humid conditions.

A 24 hour broth culture of *Staphylococcus aureus* - Oxford Strain (NCTC 6571) was counted, using a haemocytometer, and diluted with physiological saline to 10^7 cells per ml.

Polypropylene boxes (approximately 5cm deep base and 6cm high with a transparent lid) were sterilised and filled with a 3cm deep layer of vermiculite saturated with sterile distilled water. The system as set up was essentially acting as a humidity chamber.

To check the inoculum procedure the following experiment was carried out. Seven petri dishes, containing solid nutrient agar, were placed onto the surface of the saturated vermiculite in each of two chambers. The lids of the petri dishes were removed, and the chamber lids sealed into place. The humidity chamber lids had a 4cm x 2cm 'window' cut into one short side. Through this 'window' the inoculum was sprayed using a compressed air spray gun. Following inoculation, the 'windows' were sealed shut and the duplicate chambers incubated at 37°C for 24 hours. At the end of this time the agar petri dishes were evaluated for survival and distribution of the inoculum.

Table 1: Effectiveness of the aerosol as a means of inoculation

Location of Plates in Chamber	Description of Bacterial Growth
Back Left	Each plate had several hundred individual colonies evenly distributed across the surface of the agar.
Back Right	
Centre Left	
Centre Right	
Centre	
Front Left	
Front Right	

The results in Table 1 show that in the experimental protocol the inoculum is evenly distributed

The survival of microbes on a cotton air filtration medium in this system and the influence of its position within the humidity chamber was then evaluated as follows. Five inverted sterile petri dish bases were pressed down into the saturated vermiculite, to provide a dry platform for the cotton. A $5cm^2$ (0.24g) piece of untreated cotton was placed into each petri dish base, and the lid of the chamber sealed into place. Duplicate chambers were prepared. The chambers were then inoculated as described above, sealed and incubated at room temperature for one hour. The chambers were then unsealed and the cotton pieces treated in one of two ways:-

Dilution Counts - Each of the five cotton pieces was placed into 10ml of inactivation liquid (2% polysorbate plus 0.3% azolectin inactivation liquid for PHMB) and a serial dilution pour plate count carried out with physiological saline, into nutrient agar. These plates were then incubated at 37°C for 24 hours.

Overlay Method - Each of the five cotton pieces was placed onto the surface of nutrient agar and further cool molten agar poured over to completely cover them. These plates were also incubated at 37°C for 24 hours. Results are shown in Table 2.

Table 2: Survival of *Staphylococcus aureus* on Cotton

Location of Cotton in Chamber in relation to inoculation 'window'	Count cfu/ml	Overlay
Back Left	1.5×10^4	++
Back Right	5.8×10^3	++
Centre	1.7×10^4	++
Front Left	1.1×10^4	++
Front Right	3.1×10^3	++

cfu = Colony forming units
\- = No colonies visible
\+ = A few colonies visible
++ = Moderate number of colonies

The results in Table 2 show that micro-organisms are able to survive on a "dry" substrate in the humidity chamber and confirm that the inoculum is evenly spread throughout the chamber.

Example 2

Example 2 demonstrates the ability of a cotton filtration medium treated with 1% PHMB hydrochloride to inhibit bacteria when compared with an untreated control sample.

Four humidity chambers and a 10^7 cells/ml inoculum of *Staphylococcus aureus* were prepared as described in Example 1. Three samples of untreated cotton ($5cm^2$) and three samples of cotton dipped in a solution of PHMB hydrochloride and air dried were placed onto six inverted petri dish bases in each chamber. Each chamber was inoculated and incubated as described in Example 1. Duplicate untreated and treated cotton pieces were removed at time intervals of 15 minutes, 1 hour and 4 hours. The cotton pieces were treated as described in Example 1 under Dilution Counts and Overlay Method.

Table 3. Comparison of PHMB Treated C tton with Untreated Cotton

Contact Time	Sample	Count	Overlay
15 Minutes	Untreated	3.5×10^4	++
	1% PHMB	0×10^1	3 colonies
1 Hour	Untreated	1.9×10^5	++
	1% PHMB	0×10^1	0 colonies
4 Hours	Untreated	4.8×10^4	++/+
	1% PHMB	0×10^1	1 colony

\+ = Less than 20 colonies
++ = Moderate growth
+++ = Dense confluent growth

The results shown in Table 3 demonstrate the PHMB effectively eradicates *Staphylococcus aureus* inoculated onto a cotton air filtration medium.

Example 3

These experiments show the antimicrobial effect of an air filtration medium treated with PHMB hydrochloride when evaluated by an alternative protocol.

A bacterial cell suspension of *Staphylococcus aureus* was prepared in sterile saline to give a final nominal concentration of 10^6 cells/ml suspension. Aliquots (0.1ml) of the cell suspension were spread separately across the surface of eight nutrient agar plates and the plate was allowed to dry under sterile conditions. Four untreated pieces ($2.5cm^2$) of cotton and four pieces of cotton dipped in 1% PHMB hydrochloride and air dried were placed separately onto them (one piece/plate).

At contact times of 0, 15 minutes, 1 hour and 4 hours, an untreated and a treated piece of cotton were removed from the agar surfaces. When all the cotton pieces had been removed the plates were incubated at 37°C for 48 hours and the areas where the cotton had been in contact with the agar surface were examined for viable colonies of *Staphylococcus aureus*.

Growth became established in the areas which were in contact with untreated cotton. At all contact times growth was eliminated in areas on the agar surfaces which had been in contact with cotton treated with PHMB .

The test results indicate that under the conditions of this agar contact method:-

a) An Untreated cotton filtration medium does not prevent the growth of *Staphylococcus aureus*.

b) A Cotton filtration medium treated with a 1% solution of PHMB shows bactericidal activity against *Staphylococcus aureus*.

Example 4

An air filtration medium was soaked in an aqueous solution of 0.4 % of PHMB hydrochloride and allowed to dry. The sample was used to make two air filters one of which was kept unused and the other which was run in an air cleaning machine in an office for two weeks. Both samples were evaluated for the degree of contamination by both bacteria and fungi compared to controls not treated with PHMB hydrochloride by the following protocol.

Small samples were cut from each filter, and placed upon nutrient agar for detection of bacteria, and on malt agar for detection of fungi. Nutrient agar was incubated for 48 hours at 37C, and malt agar for 7 days at 25C.

Table 4: Bacterial Contamination

Filtration medium	Use	Contamination
PHMB treated	Unused	None
	Used	None
Untreated	Unused	Moderate
	Used	Heavy

Table 5: Fungal Contamination

Filtration medium	Use	Contamination
PHMB treated	Unused	None
	Used	Moderate
Untreated	Unused	Moderate
	Used	Heavy

Tables 4 and 5 show that an air filtration medium treated with PHMB is able to control the growth of fungi and bacteria both before and after use.

Example 5

Evaluation of the samples described in Example 4 via a recognised industry test, AATCC Test Method 147. A culture of *Staphylococcus aureus* was grown overnight in nutrient broth and diluted 1:10 in sterile water. Inoculating loops were loaded with

inoculum, and 5 streaks approximately 60mm long and 10mm apart were made across the surface of a petri dish of nutrient agar. Care was taken not to break the agar surface, and the loops were not reloaded. Plates were allowed to dry in air under sterile conditions. Strips of the filtration medium, 25 x 65 mm, were transferred aseptically across the 5 streaks and gently pressed onto the agar surface with a sterile loop.

Plates were incubated at 37°C for 24 hours, and the growth of bacteria on the filter and zone of inhibition surrounding the filter assessed.

Table 6. AATCC 147 Test with *S. aureus*

Treatment	Use	Bacterial growth on filter	Zone of inhibition
0.4% PHMB	Unused	None	1mm
	Used	None	0mm
Untreated	Unused	Strong	None
	Used	Strong	None

Thus, an air filtration medium treated with PHMB inhibits the growth of *S. aureus* both before and after use in a re-circulating air system.

Example 6

A comparison of the antimicrobial efficacy of an air filtration medium treated with PHMB with one treated with 3 (trimethoxysilyl) propyl octadecyldimethyl ammonium chloride using an established industry test method, AATCC Test Method 30.

A fruiting culture of *Aspergillus niger* was swabbed for spores with a sterile cotton bud. The spores were dispersed in a conical flask containing 50ml sterile water and a few glass beads. 1ml of the spore dispersion was pipetted onto the surface of a petri dish containing Czapek Dox agar. A sample (2.5 x 2.5 cm) was placed onto the surface of the inoculated agar. A further 0.2 ml of spore suspension was pipetted onto the sample surface. The inoculated plates were incubated at 25 C in the dark for 7 days. Fungal growth was assessed. Three samples were evaluated; untreated cotton; cotton treated with 0.25% PHMB by soaking and allowing to dry; cotton treated with 0.55% 3-(trimethoxysilyl) propyl octadecyldimethyl ammonium chloride by soaking, drying and curing at 100-120°C.

Table 7. Activity of PHMB compared to a 3 (trimethoxysilyl) pr pyl octadecyldimethyl ammonium chloride

Sample	Encroachment over test sample surface AATCC 30 test	Zone of inhibition mm
Untreated Cotton	total	0
Cotton treated with 3 (trimethoxysilyl) propyl octadecyldimethyl ammonium chloride	total	0
Cotton treated with PHMB	~ 25% coverage	0

Example 7 Efficacy of an Air Filtration Medium Treated with PHMB Used in a Hospital Environment

Air filters were set up and run in an open ward at Macclesfield General Hospital, United Kingdom, to test the efficacy of a PHMB treated filter compared to a non-treated filter.

The filter media used in the tests consisted of a layer of activated carbon sandwiched between two layers of woven cotton fabric. The treated filters were treated with PHMB by applying a uniform coating of a 20% solution of PHMB hydrochloride to the cotton fabric on the air input side of the filter medium followed by air drying.

Samples of the air were taken at various points within the ward with an air cleaning filter unit running with either a standard filter, or a PHMB treated filter. The effect of the filters on the airborne microbial population was assessed using the following protocol:

Determination of Microbial Population of The Air

The number of culturable micro-organisms within a known volume of air, sampled from the hospital ward, was determined using an M Air T air sampler. The air sampler was pre-set to sample 1000 litres (1 cubic metre) of air, which took approximately 5 minutes. The collected air was passed over a tryptone soya agar, a general purpose agar which will support the growth of a wide variety of micro organisms. The inoculated plates were then incubated at room temperature for 4 days prior to visual assessment and enumeration of bacterial colonies.

The air sampler was positioned at the same places within the ward for each set of air samples and was left running continuously for 7 days prior to taking the air sample. To

allow any effects of the filter to dissipate before testing another a gap of a two to three days was left between each part of the test. Two air samples were taken for each filter and each test was repeated. The average of the four measurements is shown in Table 8:

Table 8: Microbial Air Counts (Micro-organisms per cubic metre of air) in filters after 7 days continuous running:

Filter Location	Filter	Microbial Count/m^3
Nurses Station	PHMB treated	not tested
	Untreated	284
2nd Bay	PHMB treated	130
	Untreated	332
3rd Bay	PHMB treated	121
	Untreated	291
1st Bay (barrier nursing)	PHMB treated	~324
	Untreated	~700

Table 8 clearly shows that the PHMB treated filters reduced the airborne microbial count by approximately 60% compared to the untreated filters.

Number of Micro-organisms Recovered per Gram of used Filter

Samples from the treated and untreated filters described above from various positions in the hospital were evaluated for the degree of contamination by bacteria following 7 and 10 days of continuous use by the following protocol.

Small samples were cut from each filter, placed upon tryptone soya agar and incubated for 4 days at room temperature. The bacterial counts per gram of filter are shown in Table 9.

Table 9: Number of bacteria per gram of used filter medium

Filter	Location	Average Bacterial Count	
		7 Days Running	10 Days Running
PHMB Treated	Ward 1	4.00×10^3	-
Untreated		2.30×10^5	-
PHMB Treated	Ward 2	7.00×10^2	-
Untreated		2.30×10^4	-
PHMB Treated	Ward 3	1.00×10^3	1.60×10^3
Untreated		1.10×10^5	8.60×10^4
PHMB Treated	Ward 4	8.00×10^2	1625
Untreated		8.10×10^4	86250

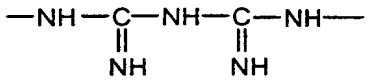
A "-" in Table 9 indicates that the bacterial count was not performed.

Table 9 shows that the number of bacteria on the PHMB treated filter medium was reduced by about 98% compared to that on an untreated filter medium.

CLAIMS

1. An air-filter for a circulating and/or recirculating air system comprising a filter medium containing a microbiologically effective amount of a polymeric biguanide or salt thereof.

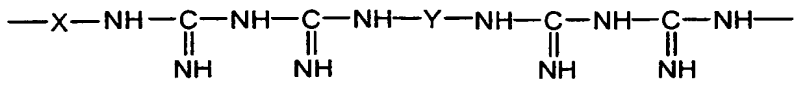
2. An air-filter as claimed in claim 1 wherein the polymeric biguanide contains at least two biguanide units of the Formula (1):



(1)

which are linked by a bridging group which contains at least one methylene group.

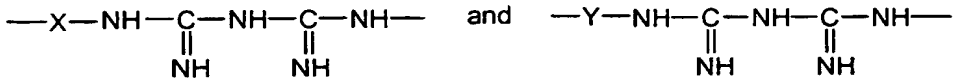
3. An air-filter as claimed in either claim 1 or claim 2 wherein the polymeric biguanide is a mixture of linear polymeric biguanides having a recurring polymer chain represented by Formula (4):



(4)

wherein X and Y represent bridging groups in which together the total number of carbon atoms directly interposed between pairs of nitrogen atoms linked by X and Y is more than 9 and less than 17.

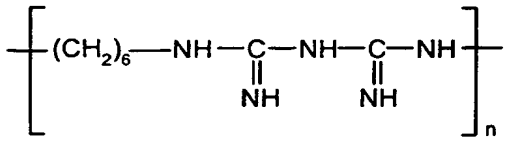
4. An air-filter as claimed in claim 3 which is a mixture of polymers wherein the number of individual biguanide units of formulae:



is, together, from 3 to about 80.

5. An air-filter as claimed in either claim 3 or claim 4 wherein the polymeric biguanide is poly(hexamethylene biguanide) in which X and Y are both $-(CH_2)_6-$.

6. An air-filter as claimed in any one of claims 1 to 5 wherein the polymeric biguanide is a mixture of polymers of the Formula (5):



(5)

wherein n is from 4 to 40.

7. An air-filter as claimed in any one of claim 1 to 6 wherein the polymeric biguanide is in the form of a hydrochloride salt.

8. An air-filter as claimed in any one of claims 1 to 7 wherein the filter medium is made from a natural polymer or synthetic plastics material.

9. An air-filter as claimed in claim 8 wherein the natural polymer is cellulose.

10. An air-filter as claimed in any one of claims 1 to 9 wherein the amount of polymeric biguanide contained on the filter medium is from 0.0001% to 10% based on the weight of the filter medium.

11. A air-filter according to any one of the preceding claims further comprising an odour control agent.

12. A method of reducing odours and/or air-borne micro-organisms in circulating and/or recirculated air which comprises passing air through a filter medium containing a polymeric biguanide or salt thereof.

13. A method as claimed in claim 12 wherein the air has a relative humidity between 20% and 80%.

14. A method for protecting a filter medium of a circulating and/or recirculating air system against microbial degradation which comprises incorporating in, or on, the medium a microbiologically effective amount of a polymeric biguanide or salt thereof.